



# **FAME Observatory Contamination Control**

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# Scope of Contamination Control Efforts



- **Requirements Identification**
  - **Review, Understand, Analyze Instrument Requirements**
  - **Contribute to the Contamination Section of Spacecraft to Instrument ICD**
  - **Develop Observatory Processing Method**
    - **Maintain Instrument Cleanliness**
    - **Maximize Ease of Spacecraft Access**
- **Provide Program Guidance**
  - **Material Selection**
  - **Bakeout Procedures**
  - **System Processing**
  - **Material and Process Waivers**
- **Maintain Instrument/Observatory Cleanliness**
  - **Implement Procedures**
    - **Spacecraft Processing**
    - **Instrument Purge/Bagging**
  - **Test/Verify Surfaces**
  - **Clean Surfaces (As Required)**



# Requirements



- **Ensure Proper Techniques and Methods Are Used in Subsystem Development for Contamination Mitigation**
- **Maintain Instrument Cleanliness**
- **Process Observatory in a “Controlled Environment”**
  - **Typically a Class 10,000 or Better Location**
  - **Occasional Class 100,000 - 300,000 Facility**
    - **Crane Operations**
    - **Environmental (Vibration, Acoustic, TVAC) Testing**
    - **Mass Properties**



# Contamination Control Design



- **Integral Instrument Purge**
  - **Purge Flow Sufficiently High to Maintain Class 100 or Better Environment**
    - **Opt 1: Class 100 Requires 250 Air Changes an Hour (Impractically High)**
    - **Opt 2: Magnehelic Measurement to Keep Instrument Internal Pressure 0.2 Psi Higher Than External Pressure**
    - **Soln: 24-30 Air Changes an Hour With Restricted Vents Will Achieve +0.2 PSI**
  - **Design Air Flow to Travel From Most Sensitive (FPA) to Least Sensitive (Baffle) Elements**
- **Baffle Design to Eliminate Spacecraft Field of View**
  - **Re-Encounter Rates Are Exceedingly Low**
  - **Less Than 1 Part in  $10^6$  for Molecular Elements**
- **Baffle Covers**
- **Establishment of Micro-Environments**
  - **Develop an Environmental Cleanliness Contour Around the Instrument**
    - **Maintain Cleanest Environments Nearest to Instrument**
    - **Key Issue Is the Flow of "Clean" Air Over the Instrument**
    - **A Downstream Polluter Will Not Effect the Upstream Environment**
  - **Vertical Laminar Airflow Tent**
  - **Appropriate Gowning Requirements**



# Contamination Control Elements



- **NCST-ICD-FM001 Spacecraft Bus to Instrument Interface Control Document (ICD)**
- **NCST-D-FM007, *FAME Contamination Control Plan - 4 Elements***
  - **Materials Selection**
  - **Instrument/Subsystem Design and Development**
  - **Observatory Integration and Test**
  - **Launch Site Operations**
- **Instrument Contamination Control Plan, P546614**
- **Ancillary Documents**
  - **Bakeout Procedure**
  - **Cleanliness Testing Methods and Procedures**
  - **Spacecraft Cleaning Procedure**
- **Surface Cleanliness Verification**
  - **Tape Lifts, Witness Plates, Alcohol Rinse, Visual Inspections**
- **Common Sense**
  - **Get Scientists, Engineers, and Technicians to Agree to Common Effort**
  - **Training to Understand Concerns**
  - **Think and Act . . . Do Not Push Limits of Procedural Rules**



# Observatory Contamination Control



- **Keep Instrument Bagged at All Times Except TVAC**
- **Maintain GN2 Purge on Instrument Until Launch**
  - **Very Few Disconnections Are Anticipated**
- **Minimize the Number of Times the Instrument Aperture Doors Are Opened**
- **Precondition the TVAC Chamber Prior to Test, and Monitoring Outgassing With TCQM & RGA**
- **Maintain Instrument and Observatory in Cleanest Possible Environment (Cleanroom)**
  - **Ensure Personnel Training and Adherence to Procedures**
- **Bus Contamination Control Methods**



# Bus Contamination Control



- **FAME Bus Structure Built Under Normal High Bay Conditions**
  - Interfaces Wiped Down With Solvent and Lint Free Wipes Before Assembly
  - Harness Is Separately Baked Out (Higher Temperature Possible)
- **Structure Is Cleaned Prior to Entering Clean Room for Propulsion System Integration**
- **Following RCS Integration, Structure Leaves Clean Room and Is Placed in Clean Tent in High Bay for Subsystem Integration**
- **After Subsystem Integration, Bus Is Baked Out in Vacuum Chamber**
  - Maintained Until TQCM Indicates Acceptable Outgassing Rate
- **Bus Leaves Chamber and Returns to Clean Room (or Clean Tent)**
- **Instrument and Bus Must Leave Clean Room for Physical Installation**
  - Do Not Have Crane in Any of NRL's Clean Rooms
  - Instrument Is Bagged and Purged, Bus Is Covered With Llumalloy
- **Observatory Is Returned to Clean Room for Electrical Integration**



# Bldg A59 Clean Room Facilities



<b>Facility</b>	<b>Best Cleanliness Level</b>	<b>Interior Size (L x W x H)</b>	<b>Entrance Size (W x H)</b>
<b>New Clean Room</b>	<b>Class 1000</b>	<b>44' x 23.7' x 20'</b>	<b>18' x 18'</b>
<b>Old Clean Room</b>	<b>Class 100*</b>	<b>35' x 29' x 10.5'</b>	<b>12' x 9.8'</b>
<b>Fixed Clean Tent</b>	<b>Class 100</b>	<b>17' x 17' x 18'</b>	<b>16' x 9'</b>
<b>Large Portable Clean Tent</b>	<b>Class 100</b>	<b>15' x 15' x 21'</b>	<b>15' x 20'</b>
<b>Small Portable Clean Tent</b>	<b>Class 1000</b>	<b>12' x 6' x 8'</b>	<b>12' x 7.5'</b>

**\*Horizontal Flow Clean Room, Rating Applies Directly in Front of Filter Bank Only**

## **FAME Observatory Dimensions:**

- Height = 8.0 Feet (on Dolly)**
- Diameter = 9.0 Feet**





# Backup

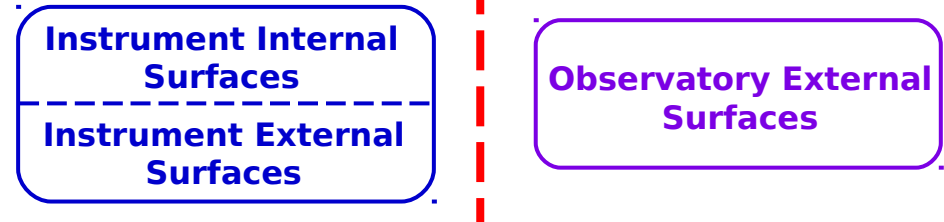


# Preliminary Design Description

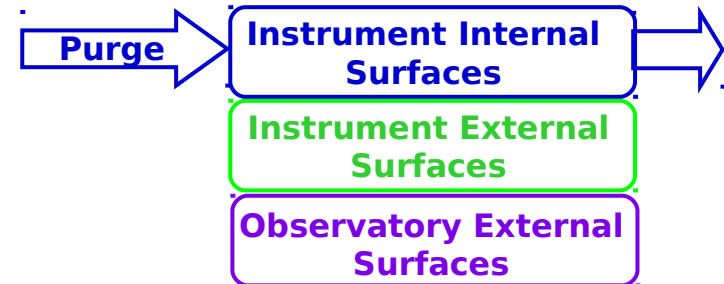


- **Goal:** Maintain Optic Performance
- **Heritage:** All Spacecraft Surfaces Do Not Need to Have the Same Cleanliness Level Provided They Do Not Directly View Each Other
- **Process:**
  - Maintain Identical Internal and External Instrument Surfaces During Instrument Development
  - Upon Observatory I&T, Instrument Purge Maintains Optic Cleanliness
    - Double Bagging Minimizes Contaminant Buildup on External Surfaces
  - Final Cleaning at Launch Site Processing Facility and Pad Close-Out
  - Minimize Surface Class Differential at Launch, Maximize Program Resources

## Instrument and Bus Development



## Observatory Integration and Test



## Launch Preparations and Closeout

